

THE
PHILOSOPHY
OF
EARTHQUAKES,
NATURAL and RELIGIOUS.

PART III.

Opinionum commenta delet dies, naturæ judicia confirmat. CIC.

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L O N D O N:

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To the Right Honourable

The Earl of MACCLESFIELD,
President of the Royal Society.

THE amazing *phænomenon* of November 1, 1755, being *All Saints* day, will prove a most memorable point in the current of time, as long as the revolution of our globe, measures it. This has induced me again to treat on the subject; a regard due to so remarkable events in our own days, our own country, among others.

Though the mere history thereof merits to be recorded, and somewhat of their manner; as far as they seem to lead us to the philosophy of these prodigious movements of nature: yet I was more particularly induced thereto, when I could not help perceiving, that they all pointed out the cause, which I had assigned, five years ago.

I have been attentive to this argument, upon every occasion that has offered from home, or abroad; and this last of 1 *November*, has in every circumstance so confirm'd it, that I hope, it will not be unseasonable to add this third part

to my former. We cannot treat on this awful subject, without a regard to religion, never to be separated from so extraordinary a power in nature. A power wherein all the four elements are engaged ; not in a mutual opposition, and friendly strife ; for in that elemental combination, the operations of nature in their usual course are carried on : but in a concurrence tumultuous, an engagement absolutely hostile.

These unbridled storms require the hand of providence to overrule them, to rebate, to direct. And this before us appears to be one of the greatest commemorated in history, like to that of *Tiberius's* time, when 13 noble cities of *Asia minor* were totally destroyed, as now *Lisbon*, *St. Ubes*, and some more. They were not swallowed up, according to the vulgar notion, and the vulgar way of expression, on these occasions, but shaken into an heap of rubbish, as now *Lisbon*, &c. They were rebuilt on the same foundations ; this happened ten years before our Saviour's baptism, and entry on his public ministry. There appeared several more of these tremors, in the *Roman* empire, about this time ; but *Asia minor* was a very conspicuous point, and prov'd a most fruitful seed-plot of the christian church in its infancy, where were the seven flourishing churches, to which *St. John* addresses the apocalypse. A judgment
this

this very proper to reduce the inhabitants to such a serious frame of mind, as is agreeable to the views of religion. And we may observe, the prophets often speak of such, as preludes to the advent of Messiah. Thus *Isaiab* xiii. 6. “ *Howl ye, the day of the Lord is at hand, it shall* “ *come, as a destruction from the Almighty.* 12. “ *Therefore I will shake the heavens and the earth,* “ *&c.*” repeated in *Joel* iii. 14. very remarkably. *Haggai* ii. 6, 7.

And these kind of portents, at all times are seasonable, to recal Christians from the riotous excesses, and love of pleasure, which is the general source of the evils in this state of things; that want to be corrected, that dissipate all reflection, promote a neglect of that soul of religion; the sabbatic duty, that corrupt the morals of mankind, and prevent the good example, which the great ones ought to hold forth, to the inferior part of the world: without which, all advice, and instruction is fruitless.

Hence it is, that Christianity, intended, and incomparably well suited, to make us happy here, as well as hereafter; to render the world even a kind of paradise, is defeated in its purpose. For did we intimately consider the matter, it is *that* alone, which gives true felicity in human affairs, even in our present state.

In my first paper on this subject, I recited the general appearances of earthquakes, in the form of axioms; as very helpful in the investigation of causes. Its now useful to repeat them, and from later observations somewhat improved, and enlarged, thus:

CIRCUMSTANCES.

I. That earthquakes always happen in calm, warm, dry, sultry seasons; or in a dry, frosty air.

II. That they are felt at sea, on lakes, rivers, even in the main ocean, as well as on land: and at that time the sea and waters are calm.

III. That earthquakes differ very much in magnitude. Some shake a very large tract of country, at the same instant of time: sometime extend to many countries, separated by mountains, lakes, seas, the ocean.

IV. That earthquakes differ much in the quantity of their vibratory motion; whence in some, though largely extended, they are innocuous: in others, both small and large, they lay all in ruins.

V. That a hollow thundering noise accompanies them, or rather seems to precede the shock; which rolls in the air, like the noise of cannon.

VI. That

VI. That they are felt more sensibly in the upper story of houses, than in the lower ; on lofty buildings, steeples, *Turkish* minorets, and the like.

VII. That the shock is more violent upon more solid buildings, churches, castles, towers, and stone-houses, than on those of slighter materials.

VIII. That many people find themselves sick at stomach, with head-achs, *vertigo's*, pains in their joints, and the like : which sometimes last for the day after, or longer.

IX. That earthquakes generally happen to great towns, and cities : and more particularly to those that are situate on the sea, bays, and great rivers.

X. That earthquakes do not cause any damage to springs, and fountains : but the water in wells becomes foul for some time.

XI. That they are frequent in the neighbourhood of a vulcano.

XII. That earthquakes often shake rocks, mountains, cliffs hanging over the sea, split them from top to bottom, throw down great parcels of them.

XIII. That fowls domestic, birds in the air, cattle in the fields are affrighted, fishes in the water much affected therewith.

XIV. That chandeliers in churches vibrate; bells in steeples and houses ring.

XV. That sometime, the hollow, thundering noise accompanying an earthquake, is heard without any motion on the earth.

XVI. That an impression or agitation in the water, is sometime perceiv'd, without a motion on the earth: at other times accompanies it.

XVII. That fire balls and meteors are frequently observ'd then.

XVIII. That the surface of the earth is chiefly, and most frequently, the object of earthquakes.

XIX. That earthquakes affect to run up rivers and sea-shores, and act more violently on places neighbouring thereto.

A due reflection on these particulars must lead us to the real cause, electricity, no other than what causes thunder and lightning, meteors, coruscations, *aurora's*, and the like aerial appearances.

The ensuing paper I had drawn up in part, to be laid before the Royal Society, but was continually interrupted by new accounts every post. From the whole I extracted what was chiefly requisite for the purpose of illustrating our main doctrine.

Being

Being at *Stamford*, in the beginning of *August* last, I heard from all hands, of the earthquake perceived there, and round the country ; on *Friday* the first of that month, at seven in the morning.

They did not scruple there, calling it an earthquake : though no movement on the earth was observed, only the horrible noise above head, always accompanying an earthquake.

After my return to town, I received a letter from our ingenious correspondent Mr. *Thomas Barker*, of *Lyndon* in *Rutland*, giving a very precise rehearsal of what he observed therein. Whilst I was transcribing the particulars, in order to lay them before the Society, we have had such numerous, and continually repeated accounts of these dire disasters, well nigh thro' all *Europe*, happening this year, that I could not avoid making mention of them all. But as these bare relations may be accounted only matter of history, I shall speak somewhat of their cause, and their diversities ; which is more properly the business of the Society : yet with conciseness ; because my sentiments concerning them, have been already delivered in print.

Mr. *Barker* writes, that about 40 minutes after 6 o'clock in the morning of that first of *August* ; standing against a north window, he heard a

con-

continual rumbling noise, like a long clap of thunder, as if about four miles off.

At first he thought it such, but as not a cloud was to be seen, the sky being perfectly clear, he could not conceive, that it should be thunder.

Then he took it for a wheelbarrow, rattling over the stones, just under his window. Others in the house heard it, and fancied, something was fallen down, and rolling about, above stairs. Others in the village supposed it to be the rattling of a coach, or a cannon let off; or the shooting down stones out of a cart, or the like.

Many describ'd it with a great thump (so they term'd it) accompanied with the rumbling. Some said it was louder than any thunder they ever heard: and that cattle in the fields were much affrighted at it. All agree the noise lasted some few minutes. Some say they heard a great thump again.

It is reported, that a ball of fire was seen just before; and a great flash of lightning.

Mr. *Barker* says, that immediately going abroad, he saw low in the northwest, a faint white hazyness in the sky; the rest of the heavens quite clear. Yet an hour after, many scatter'd clouds appeared from that quarter, the wind being from thence: so that the day was lowering,

lowering, yet fair and windy, till the evening. Then a slight shower fell. But the weather had been moist and showery before. And after this, it rained every day, more or less, for some time. The barometer was now 29. 6. beginning to fall.

Some discerned no concussion in the earth: others declare positively, that the ground shook under them. One walking between *Ketton* and *Tinwell* in *Rutland*, said; the concussion was violent. But the noise was heard all over this county of *Rutland*: as also at, and beyond *Stamford*, *Grantham*, *Lincoln*, *Melton-Mowbray*, *Waltham*, *Leicester*, *Nottingham*, *Kettering* and *Rushden* in *Northamptonshire*. They say, at *Lincoln*, it was repeated again, at 12 at night.

But a concussion was felt in the morning, and the noise very loud, upon the hill country to the north of *Lincoln*; between the rivers *Trent*, and *Ankam*. So that they concluded, many cannon were fired at *Hull*. Some supposed many horses at waggons, were all together running away, down the steep hills, from the Heath. It actually shook many houses, and the walls of some fell down, about *Frodingham*, *Burringham*, *Lodington*, and *Adingfleet* near the *Humber*. Some houses shook so, and trembled, that the walls seemed as though they would meet.

I received likewise a letter from *Thomas Whichcot* Esq; knight in parliament for the county of *Lincoln*, intimating, that all the parts of that country were sensible of it: both by their eyes and ears; from the motion felt, and from the explosion, or noise accompanying. He adds, upon reflection, he has the greatest reason in the world, to judge, its cause to be aerial.

Assuredly, we may make this observation upon what has been said; that the horrible noise heard around so large a space of country, and which always accompanies an earthquake, must not acknowledge any subterraneous origin; and can be no other than an electrical shock, a stroke in the atmosphere, the same as makes thunder. That the concussion of the earth being but partial plainly intimates, there was not an universal propensity in the earth's surface, to receive the shock; it was not in a proper degree of electricity. And this we might well expect, from the moist state it must needs be in, when the whole year round, the weather has been rainy, to an extraordinary degree.

Whilst I was writing this, a letter appeared in the *Public Advertiser*, for *Monday* the 10th of *November*, from a gentleman in *Yorkshire*; giving a circumstantial account of that earthquake, which happened on *March* the 25th last,

last, at *Black Hameldon, Yorkshire*, near the place famous for the annual horse-races, and held there in autumn, with a vast concourse of people.

I judge this anniversary meeting to be a continuation of the solemn *panegyres*, or quarterly assemblies of the Druids, for a publick sacrifice; which were always accompanied with sports and horse-races.

At the neighbouring *Ofmotherly* on the same hill, is another great meeting held to this day, with horse-races at the summer solstice; called still the Midsummer-games; a like remain of the Druids. And there are some ecclesiastical privileges now subsisting at the church.

We had a letter concerning that earthquake, read at the Society, on *May-day* last, from a gentleman at *Ellenthorp*.

The writer of the 10th of *November* last says it began with a vast thundering, which affrighted the horses and cattle. That the surface of the earth rose and fell, like ridge and furrow, in plowing; *i. e.* in waves, or vibrations: though he had the common wrong notions of subterraneous explosions, fires from *pyrites*, and the like fancies.

He describes it further, as a great roaring noise, like many cannon let off; or loud and rolling thunder. It seemed to come from a
great

great ridge of the cliff, on the south-west of *Hameldon* hill; particularly from that part called, *Whiston-cliff*, which I take to mean *White-stone*. It is a vast and high rock, white in colour, and conspicuous all the country round, to a considerable distance. It is of no consequence to recite the descriptions and various appearances, which these writers give us, from antiquated apprehensions, of the cause of these *phænomena*: but in substance, it is certain, that a vast portion of the solid rock was struck down, by the electrical shock, from top to bottom of the cliff.

This was done in a perpendicular line, as if cut smooth with tools of a mason. It is described to be fifteen yards thick, thirty high, above sixty broad. This was thrown down into the valley, split into many pieces; some of which were cast to the distance of five or six hundred yards.

Our writer then reasons upon the subject. Was it effected, says he, by “ a merely natural
 “ cause, if so, that cause must have been either
 “ fire, or water, or air. It could not be fire,
 “ for then some marks of it must have appear-
 “ ed, either at the time, or after. But no such
 “ mark does appear, nor ever did: not so
 “ much as the least smoke, first, or last. It
 “ could not be water, continues he, no water
 “ issued

“ issued out, when the rock was torn off. Nor
“ had there been any rain before : In that part
“ of the country, a remarkable dry season.
“ Nor was there any cavity in that part of the
“ rock, wherein a sufficient quantity of water
“ might lodge. He concludes, there remains
“ no other cause, but imprison’d air, which he
“ acknowledges equally insufficient for produ-
“ cing the effect.”

At length he makes it merely supernatural.
But though we allow it to be the effect of a di-
vine hand, yet that hand can work sufficiently by
means of the power of the electric stroke of the
elemental fire, spread through all nature. And
that hand can direct the stroke, both as to place
and time, as best suits the purpose of a celestial
monition : where there is so great a concourse
of the nobility and gentry every year, according
to our writer’s hint. “ This is wrought, says he,
“ in such a manner, that the *many* may see it
“ and fear : And travelling along one of the
“ most frequented roads in *England* ; who must
“ see it, whether they will or no, for many
“ miles together.

“ Further, it must, for many years, maugre
“ all the art of man, be a visible monument of
“ God’s power.”

These and the like are this Gentleman’s just
and pious sentiments as to the moral purpose of

these wonderful appearances. And it is very obvious to inforce the same sentiments, from the many like, and much more dreadful earthquakes since, which this year, fruitful in those natural prodigies, has afforded us all over *Europe*.

For we have found them chiefly directed to great cities and towns. So that if we believe Providence is concerned in the government of the world, we cannot help looking on them in the view of celestial monitions.

Indeed, since I set pen to paper, in this memoir, I have been continually interrupted, with more and more of these shocking accounts, every post: which have unavoidably carried it far beyond its intended bounds.

I am much mistaken, if our philosophical solution of the cause, as well as the assigned purpose of earthquakes, will not be strongly corroborated by a bare recital, which we must needs make of them.

On *Saturday* the 24th of *May* last, an earthquake was felt at *Tame*, and *Lillingston* in *Oxfordshire*. The surface of the earth, and houses were much shaken, but no damage done. That same day, I rode from *Oxford* to *Windsor*: Having delivered Mr. *St. Amand's* fine library, which he bequeathed to the *Bodleian*.

Saturday

Saturday the first of *November*, we had an account in the News Papers, of a strange agitation on the water, in the port and docks of *Portsmouth*: so that some ships rolled fore and aft; others from side to side. But no motion was perceived on the earth. We have lately received a more particular relation of it at the Society. As likewise of the same *Phænomenon* at the same time, between 9. and 10. *Mat.* at *Plymouth*, from Dr. *Huxam*, who judiciously suggests its true cause, an electrical stroke: but this was felt likewise somewhat upon land: as at *Pool*, both on land and water.

Since then, we have had ample accounts both of the agitation on the water and real earthquakes from *Swansey* in *Wales*, from the coasts of *Sussex*, *Surry*, *Kent*, and up the inland parts, *Godalmin*, *Guilford*, *Cranburn*, *Sherburn* castle, *Oxfordshire*, *Luton* in *Bedfordshire*, *Enfield* near us; moreover it was observed at *Peerless-Pool*, a large body of water by *St. Luke's* in *Old Street*. It was found too at *Whitehaven*, *Cumberland*; and in *Loch-Lomund* in *Scotland*, *Lochness*, &c.

The same was felt half an hour after nine in the morning at *Cork*, *Ireland*; with a considerable shock of an earthquake. The motions on the surface of the earth, are described to be

short, and tremulous. It was quite confined within the bounds of the town.

The electric stroke was felt on the water only, at *Kinsale*; not the least breath of wind blowing. The water did not rise gradually, but with a hollow and horrid noise, rushed in like a deluge; rose six or seven feet in a minute, and as suddenly subsided. It was as thick as puddle, very black, and stunk insupportably; being stirred up from the bottom of the harbor. Very great damages done to the shipping, which were whirled about like so many corks, and dashed against each other; many were thrown high above land, and there left. It came by fits, at a quarter of an hour's interval; to the infinite amazement of the inhabitants, who feared doomsday was at hand.

Thus fared it with the *Britannic* isles. And reason sufficient have we, to acknowledge the kind indulgence of providence! but since we have been beyond measure alarmed, with this terrible judgment taking its hideous steps, over the continent; and *Africa*, and *East* and *West Indies*: whereof we must note some particulars.

First, we heard of it from *Amsterdam*; the weather calm, as always is observed. The chandeliers in some churches were found to vibrate; which shows a slight motion at least,

on the land, as well as on the fluid element. But the agitation there, was felt in many parts of the province; particularly at the *Hague*, *Leyden*, *Gouda*, *Rotterdam*, *Leerdam*, *Henkelen*, &c. It was observed to run up the rivers *Weser* and *Elbe*. That it is a property of electricity, I have formerly taken notice of. After this, we find it, the same hour, at *Hamburg*, and *Lubec* in *Holstein*. The water in the *Trave* rose four or five feet perpendicular, and subsided alternately, and instantaneously, for a long time. The ships snap'd their cables. Great damage done to the vessels in general. The like notices from *Gluckstad*, and other places thereabouts, accompanied with a real earthquake. It affected the river *Eidar*. The people at *Rensborough* at prayers in the new church, observed three large branches suspended from the roof, vibrated very much, from east to west. They weighed twenty hundred each. That over the baptismal font, not so heavy, not so much affected. The water of the *Stahr* greatly agitated at *Itzeboe*: and a large float of timber was thrown on the bank.

The water surrounding fort *Steinburgh* threatened to overthrow the fort: those of the *Ave* the like, at *Vetersen*. The branches in the church too vibrated at *Emsborn*, *Bramstat*, *Wilsler*, *Kellinghusen*, and *Melidorf*. The Waters

of the *Schwinge* and the *Oost*, greatly agitated, and at *Cuchaven* and other places beyond the *Elbe*.

From *Berlin* they write, the weather being perfectly calm; the agitation in the waters was found in the lakes at *Templin*, *Netzo*, *Mahlgaſt*, *Rodelin*, and *Libbeſc*. The water ebb'd and flow'd ſix Times in half an hour. The fiſhermen at *Netzo* ſaid, that it had an inſupportable ſtench; which ſhews, that the force affects the water, to the bottom of the ſea. It was accompanied with a moſt frightful noiſe.

It was obſerved too in *Norway*, at *Dalecarlia*, and ſome other provinces in *Sweden*. At the ſame time, the rivers, and lakes were extremely agitated.

The ſame day and hour we hear of it at *Madrid*, in form of a real earthquake. It ſhook the *Eſcurial*, ſo that the royal family were obliged to abandon it. Several perſons were killed by the falling of houſes. The people all fled. *St. Andrew's* church was rent in ſeveral places.

The ſhock was felt at *Bilboa*.

At *Oporto*, ſeveral houſes were quite deſtroy'd: Some churches and ſteeples much damaged. By the ſudden ſwelling of the ſea, the water run higher up, than any tides had ever reached.

The

The town of *Setuval*, or *St. Ubes*, a flourishing place, quite destroyed, and many ships sunk. The chain of rocks on the west side of the town, which contained the quarries of the fine jasper marble of various colours, so valuable, split and rent.

Malaga likewise felt a violent shock of an earthquake. The bells rung in the steeples. The water in a well overflow'd, and as suddenly retir'd again. There it was repeated: and the people were seized with the same foolish panic as with us, five years ago; and totally deserted the city for a whole night.

Great damages done at *Granada*, at *Cordova*, *Anteguera*.

It was violent at *St. Lucar*, and *Sevil*, where the most magnificent cathedral has received much damage. Many persons killed. They look'd on it as the Approach of the day of judgment. The sea swell'd to an amazing height, and enter'd the city, almost destroyed it. Not a single church or convent has escap'd without damage, and few houses. The borough of *Triana*, the villages *St. Juan*, *Dalgarache*, *Gilbes*, *Brines*, *Camas*, and many others in the neighbourhood demolished. The city of *A-reos* likewise.

It passed above 30 leagues along the sea-coast ; breaking off large rocks toward the shores, which fell into the sea.

At *Cadiz* the *French* consul lost his life. The sea carry'd away a vast length of the wall, and of the mole : destroy'd the long caufway of two miles, with many people, cattle and carriages upon it, flying from so terrible a calamity.

It was felt in the island of *Chichlana*, at *Medina*, *Port Real*, and *Cheres*.

It was violent in *Faro* in the kingdom of *Algarva*, quite destroyed it ; and *Lagos*. Felt at *Silvas*, *Villa-nova*, and all the sea-coast, from cape *St. Vincent*, to the river *Ayamonte*.

The Agitation of the water was strong at *Porta Maria*, at *Salamanca*, *Segovia* ; very terrible at *Valentia*, *Coimbra*. The cathedral church, the jesuits magnificent college, the church of holy cross, the dominican monastery of the inquisition, and other great edifices entirely destroyed there. At *Braga* the same.

At *Gibraltar*, the morning was clear, it began with a terrible rumbling noise as usual : then a trembling and violent shock. After a second trembling, another shock. The guns on the batteries plainly rose, and fell, like waves : the earth having an undulatory motion. Several things thrown off the shelves ; and the

gable end of two houses rent. Most people seiz'd with giddiness, and sickness, stupified; some fell down. They that were walking, or on horseback, felt no motion, but were sick. In general, all were affected, as if electrify'd, so they themselves express it. The sea much agitated. The ships trembled, and felt a thump at the bottom. The *Dutch* ships off cape St. Mary's, fir'd guns of distress, thinking they struck on ground. A large piece of the rock was split off, into the *Catalan* bay.

At St. *Roque* persons toss'd out of their seats. An arch of the church rent.

At *Algazeist* several walls fell down, and great part of the town overflow'd.

At *Estapona* the church much damag'd.

Now it pass'd into *Barbary*. At *Arzilla* the water rose nine Feet. At *Tangier* they say 50, perpendicular.

Mequinez has suffered much. Two thirds of the inhabitants destroy'd. A great mountain split, whence a torrent of water ran for some days. All the whole coast of *Africa*, with a dozen cities destroy'd. *Algiers*, *Tunis*, *Fez*, *Morocco*, *Salle*, &c.

Return we to *Europe*. The island of *Minorca* was pass'd over. Most of the provinces in *Spain*, felt its fury. But the whole kingdom of *Portugal* was involv'd in a general desolation.

The

The great, the populous, the rich, the splendid *metropolis*, and royal palace of *Lisbon*, totally destroy'd.

It was felt likewise in *France*. At *Bordeaux*, both the shock and the agitation of the water. The river *Soane* by *Lyons* overflow'd so suddenly and violently, as to do a great deal of mischief. The like, in other parts of that kingdom.

The whole islands of *Sardinia* and *Corfica*, were shaken; and the waters agitated very much; and by overflowing, done a great deal of mischief.

At *Turin* a severe shock. At *Bazil* in *Switzerland*, and the neighbourhood. The lake of *Zurich* much agitated. Felt at *Strasburgh* and *Stutgard* in *Germany*.

This same earthquake was felt the same time, in the *West-Indies*, in the island of *Barbadoes*.

Further the electric stroke exerted its fury, on the mountains in *Portugal* and *Algarva*, as well as cities; on the largest mountains and ridges of mountains, such as *Estrella*, *Arrabida*, *Marvan*, *Sintra*, *Monte Julio*; they were shaken from the foundations, and most of them open'd at the summits, split and rent, in a wonderful manner, huge masses of them thrown down into the subjacent valleys.

There is no city or place of note in the kingdoms of *Portugal* and *Algarva*, but wha
have

have suffered more or less : *Villanova, De Portimano, Taveira, Castro Marino, Beja, Elvas, Portalegre, St. Ubes, Cascaes, Sintra, Santanem, Coimbra, Castello Branco, Lamigo, Oporto, Viana, Braga, Guimaraens, Villareal, Braganza, Pinhel,* and others.

It was felt all over *Spain*, except in *Catalonia*, the kingdoms of *Aragon* and *Valentia*.

The rivers particularly subject to its influence, prodigiously swelled, the *Guadiana, Minho, Douro*. It passed up the *Tagus* for 300 miles, as high as *Toledo*, and did damage all the way, on both sides.

We have many accounts of ships at Sea, in the middle of the great ocean, participating in this amazing *phænomenon*. A very loud thundring Noise begins it, it seems, as if casks were rolling about upon deck. The masts, the whole ship tremble like a reed shaken with the wind. A great thump felt at the bottom of the ship, as if it struck upon a rock. The Compass often overturn'd in the benacle. The earthen ware, bottles, and the like broke. If in the night, flashes of lightning appear, fire-balls. The compass often loses its directive power.

But the tremendous Tragedy of *Lisbon* presents us with a picture of all human woes accumulated. We should shudder at the description,

tion, which therefore I forbear, But the principle of electricity sufficiently display'd itself, nor needs any accurate dilucidation : It began with a terrible, rumbling noise, as usual. The shocks heaved up the most ponderous edifices, and shook them as branches of trees, by the wind. The houses bent, or nodded to and fro, like the masts of ships just mention'd, till they tumbled down ; the upper parts of them first. So the steeples, and towers of churches. The ground and the streets danc'd under their feet, as they fled, like the wire of an equilibrist. They express it by the term of undulation, and trembling. Sometime it was so violent, that they were oblig'd to lie down, or kneel, not able to keep on their feet.

The city of *Lisbon* is founded on a rock of marble ; so much the more susceptible of the electric power, which gave it the vibration. Hence the ruins of churches, palaces, houses, lie upon their foundations, respectively ; as the houses of cards made by children, thrown down by a slight shock of a table. And so we are to understand of all the rest, in other places.

Here they tell us expressly, that there were not any eruptions in the city, fiery, or otherwise. But the fires which caused the consequent conflagrations, proceeded from the lamps in churches, and the culinary fires, in the houses.

houses. Some places were set on fire, by villains, for sake of plunder.

They tell us expressly, there were no chasms in the earth, in or about the city, nor all along the coast.

The ships were likewise much agitated. The air in a perfect calm. The water in the river rose 20 or 30 feet several times.

Beside all these recited, this fruitful year of earthquakes has produc'd many more, in every part of the globe ; both before and since the fatal *Nov. 1.* as at our colonies in *America*, at *New-England*, where it did a great deal of damage to the houses at *Boston*, particularly the upper part of them, and more to the brick buildings, than the timber ones.

At *Philadelphia* on *Nov. 20*, a smart shock.

At *New-York*, the morning calm, not a breath of wind stirring.

A most furious earthquake happened this year at *Cachan* in *Persia*.

Fresh earthquakes have happen'd in *Holland*, and agitations on the waters : Particularly both at *Leyden* and *Amsterdam*, the water in large vessels for brewing, were sensibly affected.

The like at *Geneva* on *Dec. 9*, in *Franconia*, the dutchy of *Wirtemberg*, *Suabia*, the *Brisgau*, *Alsace*, most parts of *Swisserland*.

At

At *Milan*, Dec. 9, violent. The water extremely agitated. Great buildings rent. Furniture of private houses thrown down.

From *Maestricht* on the 26th, a shock. At the same time at *Nimeguen*, *Arnheim*, *Venlo*, *Cleves*; in the *Weterau*. Also at *Niewied*, *Bonn*, *Cologne*, *Coblentz*, *Neufs*, *Dusseldorp*, *Juliers*, *Duren*, *Stolberg*, *Stablo*, *Malmedi*, *Spa*, *Verriers*, *Barico*, *Neaux*, *Aix-la-Chapelle*, *Liege*, *Lidt*, *Namur*, *Mons*, *Ath*, *Louvain*, *Molmies*, *Breda*.

On November 17, an earthquake felt about *Whitehaven*, *Cumberland*. A most violent tempest of rain and lightning, at the same time, with us at *London*. Mr. *Barker* writes from *Lyndon*, *Rutland*, that it was a very tempestuous night. Men ringing the bells at *Ridlington* church, beside the wind and rain, heard a most affrighting noise, as if the steeple was tumbling down, which made them all run out of the church. The same noise was heard by others, in their houses, in the same town.

December 18. an earthquake said to to be upon the river *Wye* in *Herefordshire*, attended with a great rumbling noise, to the astonishment of the neighbourhood, who thought the world at an end. A cliff with the trees growing on it, were struck down into the river.

Thus

Thus we have recounted a short, and general view, of this most wonderful, and to many persons and places, fatal effects of this great power of nature, which we call an earthquake : chiefly on that *Nov. 1.* The name of earthquake given by our ancestors was, with much greater propriety, than usually attended to ; and which carries evident tokens of its true, and genuine cause.

We have since lost sight of it, by our descriptions deriv'd from a prepossession, in favour of a wrong cause ; fiery eruptions, vapors, gaping ground, and the like. Whereas 'tis really a quaking, or *tremor* only of the earth, of the surface of the earth : not like the rending, and explosion of a mine of gunpowder, at the Siege of a town, which tosses up all before it, or above it, men, stones, and earth, into the open air.

We have only recited the places, and chief circumstances, which show its cause : which we are to understand, as a merely superficial vibration : no chasms, sinking of towns, cities, mountains, rivers, or the like fanciful appearances. But historiography is not the only purpose of the Society. We must endeavour to find out the causes of things.

It is indubitably owing to the power of electricity, exerted in the atmosphere ; the same as
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makes thunder and lightning. This power subsists in a vibration. The stronger and more solid the matter excited by it, the stronger are the vibrations. Whence cathedrals, churches, palaces, goals, castles, towers, rocks, stone-houses, and firmer kind of buildings suffer most, and first: just as the philosopher some time since, applying a cannon, instead of a slighter conductor, in his electrical experiments, met with his fate, from the violence of the shock.

That these portents of nature always happen in a calm, in dry weather: that the cattle in the fields are affrighted at it; that the prelude is a most horrible noise: that it affects ducks, and geese above water, fishes in the water, fowls in the yard, birds in the air; all shows an aerial cause.

The same is pronounced of the sickness, *vertigo* and the like, seizing men and women, especially of weak constitutions, in childbed, or lately handled with a disease: of which I know several instances, besides those commonly recited: that balls of fire, coruscations accompany: that a quarter of the globe was here affected at the same time, both land, and ocean; *Britain, Ireland, from Norway to Morocco, and Barbadoes Island*: that bells rang in steeples, in houses, chandeliers vibrated in churches: that

that this effective power runs along rivers, sea-shores, touches maritime places chiefly; indeed all its appearances whatsoever consider'd free from old prejudice, effectually discharge subterraneous fires, *pyrites* and cinnaber, from blame; and assert the electrical shock, its genuine cause.

They that can fancy such fires running across the solid globe from *Cornwall* under the ocean, to *Barbadoes*, to *Portugal*, *Africa*, *Norway*, like squibs in the air across a street, are not to be argued with.

On the 11th *November* this year, a smart shock of an earthquake at *Philadelphia* in the *West-Indies*. The like at the same time at *New York*. The same in *New England*, at *Boston*.

The same was felt at the same time, at *Norden Syssel* in *Iceland*. A violent shock at *Husewig*, and upon the water. We can acknowledge no other than an aerial cause to touch countries so distant.

From the journal book of the ship, the *Queen of Hungary*, Capt. *Veale*; I received this extract: It lay under the King's palace at *Lisbon*, Nov. 1. last. The weather more serene and calm than usual. About 40 minutes after 9 in the morning the shock began, with a strange and frightful rumbling noise, seeming to descend from the atmosphere. Toward the evening a violent shock

completed the ruin of the city. It was preceded, and attended by most terrible lightnings.

And a great ball of red fire, in appearance as big as the sun, was seen.

These were now visible, as being in the night: when in the day time, invisible.

In so surprizing an effect as an earthquake, and so unaccountable a cause as electricity, a cause but recently considered, or known, is it to be wondered at, if some difficulties occur? can we yet pretend to unriddle all the secrets of electricity; though we know some: and in my apprehension are sufficiently clear, as to the efficient before us?

Some objections there are, not insuperable. For instance; in electrical experiments the shock is single, and momentary; but earthquakes are felt for some few minutes.

To answer which, we need not urge; how fear and frights multiply, and magnify objects, and appearances. But suppose the vibrations of an earthquake last two minutes, there can be no comparison, between our little *apparatus* in experiments, and the stroke upon seven hills, whereon *Lisbon* is built. The vibrations of musical strings are in proportion to their length, and thickness: the same of bells, and the like. There is no comparison between the snap in our
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little experiments, and a shock upon the globe of the earth ; whence the horrible noise rolling from one eminence to another : as in the air, the thunder is re-echoed from one cloud to another.

Again, some find difficulties from apertures in the earth, and sinkings into the sea, as is the case of the key at *Lisbon* ; and the like. So as to mountains opening, and rivers of water gushing out. I profess these instances move me not in the least, to derive them from the bowels of the earth. The electrical stroke from the atmosphere must divide a key, and push it into the sea, or a street that stands on a cliff ; as it divides rocks, cliffs, mountains ; and tumbles them down, like as the above recited case of *Whitestone cliff, Yorkshire*.

In mountains we expect reservoirs of water, whence springs and fountains flow, by an inexplicable operation of nature. And why may not electricity push rocks, and small islands into the sea. Though probably several of these cases are reported only from relations, under a false notion of the cause.

Some may object, that if the earth was electrified on an earthquake, every person ought to feel it ; as when touch'd in the electrical experiments. But we know, the persons in a room where such experiments are try'd, are not ne-

cessarily electrified. Yet we find in earthquakes in fact many affected, as if electrify'd, by sickness: And all kind of animals are fully sensible of it, and extremely disturbed.

Sometime, the case of *Herculaneum*, and such fancied accidents are quoted, as places sunk, by force of an earthquake. But this is an erroneous position. The city remains intire. It was not shaken in its last *catastrophe*, but buried in the *lava* poured upon it from mount *Vesuvius*. These and such like, are little objections, which it is not worth while, to be elaborate in answering; as having no foundation on principles of philosophy.

I May 1751, I received a letter from *Peterborough*, by order of the literary Society there, with an account of a woman at *Sutton* by *Wansford*, who had been quite deaf for two years last past, but was perfectly restored to her hearing, on *Sunday 30 September* preceding, being the day of the earthquake there. She found herself restored half an hour before the shock.

April 1751, we had an account from *Edenburgh*, of a person restored to the use of speech, from a resolution of the nerves, by electrifying. His name *Robert Mowbray*. These and many like cases confirm our reasoning.

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Though the power that produces these amazing struggles in the elements, be manifestly one, and the same, yet it admits of some difference in its action; not only as it may be more, or less forcible, of more or less extent, or as to the different object of its action, but likewise in its manner. And this points out some names of distinction, which are at least useful, in all parts of learning and philosophy.

I. We may therefore denominate one of these appearances, the *air-quake*. This shows itself only in the air, in a most horrible rumbling noise, like many cannon let off, echoing from one hill to another. It may be called terrestrial thunder. The earth feels not its force, or but slightly, or partially, here and there; must not be thought to be in a proper electric state, and therefore not fully susceptible of the shock. This is owing to a preceding rainy, moist season: which is always adverse to electricity.

A loud clap of thunder in the atmosphere, may be heard over a circle of 500 miles diameter. The same clap discharged at the surface of the earth the 1st of *August* last, was heard all over the counties of *Lincoln* and *Rutland*; and part of all the circumjacent counties. It arose to an earthquake, wherever the ground was in a proper
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per disposition for it, more or less. They that can suppose this *phænomenon* to arise from underground, are not to be argued with.

2. A second kind we may call a *waterquake*; which exerts itself in the air, and water, as this on Nov. 1. with us; causing a most vehement agitation of that element, lifting it up, and throwing it down by pulses, tossing it over the banks of canals, whirling about ships, and boats, shaking, and dashing them one against another, stirring up the water from the very bottom : raising it from the bottom of Wells, and the like.

This appearance occurs in the middle of the ocean : on the land, here and there accompanied with real shocks of an earthquake, wherever the earth is in an electric state. This *phænomenon* must acknowledge the same aerial origin.

The water is a ready object of its force, both from its mobility, and from its solidity. It chuses to run up rivers, to any length : to run along the shores, as ready conductors. They that can fancy subterraneous boilings like a culinary fire, under all the canals, lakes, rivers, sea-shores, and the ocean, affected at the same time, over a quarter of the globe, especially in the vessels of water prepar'd for brewing, are not to be argued with.

We are to conceive, that the electric power falls furiously on the water, by reason of the extreme solidity of the component particles of that most wonderful fluid element : whose sole property it is, of all matter, to be absolutely incompressible. Hence it more readily attracts, and assists the vehemence of the elemental, electric fire. Hence it so readily falls on rocks, mountains, steel, solid buildings, metals, the bones, and joints of animals, and whatever is of most specific gravity.

This therefore causes a thump at the bottom of a ship in the sea, as if striking on ground ; this shakes, and quivers the masts, like an aspen leaf.

3. The third diversity, we call properly the *earthquake* : a *tremor* of the surface of the earth, accompanied with the two preceding, especially the first, the rumbling noise. These undulations are boundless, as to space, time, or violence ; as far as the earth is prepar'd to receive them. For if a musical string be not rightly stretcht, it has no tone. So a wire in electrical experiments never so far extended, receives the touch, through its whole length.

It cannot be hard to observe, that all considerations show the impossibility of a fire underground perpetrating these dire calamities of earthquakes. The like as to the agitation in
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the waters, which was perceiv'd even in great vessels of water for brewing : and more, even in lead when in fusion, at that same instant of time, as I was credibly inform'd.

We must likewise affirm, that the fire, and smoak of vulcano's, is the effect of the electrical stroke, not the cause. The great noise is prelusive of the fire, that kindles their component sulphurs, at the very summit; like a match of brimstone struck by a flint and steel. Nor can there be any fire, low in the earth; where there is no conveyance of air, no more than in an exhausted receiver. And though fires are found in the bottom of coal-mines, and the like, where the air can descend; yet we never hear of earthquakes caus'd by them.

4. A fourth kind, I hold to be what we vulgarly call a *waterspout*, which is seen both on the water, and on the land. 'Tis a partial exercise of the aerial power, that lifts up the water in the ocean, rivers, wells, canals. A single *vortex* or column, sometimes visible of a great height.

In the accounts from *Cadiz* and other places, the water is seen coming from the great ocean, like a mountain, and when at the shore covering the land : and many of these like columns or ridges 50 or 60 foot high, more or less, succeeding one another. The like appearance *cæteris paribus* in lakes, canals. All these are
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twing to the same aerial power that makes the water-spouts.

All these four kinds proceed from the same cause, under some differing circumstances, single, or complex, greater or lesser. The *rationale* of them we leave to further disquisition, content to point out some of them, and enumerate their *species*.

I shall mention a pertinent observation of our friend the learned Dr. *Pocock*, archdeacon of *Dublin*; in his excellent description of *Egypt*, pag. 195.

“ It has hardly been known, says he, that
“ they had any earthquakes which did mischief,
“ in *Egypt*; and those that rarely happen’d
“ were scarce perceivable. But in *January*
“ 1740, they had three great shocks, imme-
“ diately, one after another; which threw
“ down some mosques, and several houses. It
“ being a year of scarcity (therefore dry, from
“ failure of the *Nile*) all the people prayed
“ for plenty of corn. As they have a strange
“ notion, that at such times, the Heavens are
“ opened, and their prayers heard.”

Affuredly, this notion of the *Egyptians* may be accounted orthodox, as well as philosophical. They look upwards for the cause, as well as the use, to be made of these extraordinary movements, under our feet. Happy are we,

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if we think in the same manner. It may put us in mind of one circumstance, seen generally throughout all that we have hitherto spoke of. The chief instances of earthquakes are notoriously directed to cities, great and rich towns, places of traffick and concourse, that the numerous inhabitants may be induc'd seriously to take warning at such judgments, and apply to the Divine Being, *whose majesty is as his mercy.*

Is it not a manifest intimation of a supernatural hand, that directs these natural causes, these elemental convulsions ; and of infinite goodness ; when in the almost universal destruction of the city of *Sevil*, for instance, only four persons lost their lives.

To come home, how ought we to adore the good providence of God, who spar'd us of this island, in so wonderful a manner ! turning what we reckon'd a calamity, into the greatest blessing ; I mean the rainy season last winter, and spring, and summer, and autumn, and the present winter, which we may justly conclude, sav'd us from the hideous ruin of the more southern climates.

Even in the extreme *catastrophe* of *Lisbon*, where more than 40,000 persons are most miserably perish'd, about a score only of our countrymen are involv'd in the number. And the only buildings left standing, are the *English* and *Dutch* protestant chapels. I

I shall conclude this essay, with a piece of criticism reminded by a learned friend Mr. *Woolfe*. We have seen universally, that all these earthquakes and agitations happen in a serene sky. We have asserted their cause to be electrical strokes from the atmosphere, the same as thunder and lightning. Now, that thunder and lightning which produces earthquakes, is found in a clear sky, free from clouds, was known to that great genius *Horace*, as appears very fairly, from ode xxxiv. of first book; but not commonly understood, from want of a true pointing. Thus,

*Parcus deorum cultor & infrequens,
Insanientis dum sapientiæ*

*Consultus erro; nunc retrorsum
Vela dare, atque iterare cursus
Cogor relictos. Namque Diespiter
Igni corusco nubila dividens*

*Plerumque; per purum tonantes
Egit equos, volucremque currum.
Quo bruta tellus, & vaga flumina
Quo Styx & invisi horrida Tænari
Sedes, Atlanteusque finis
Concutitur.*

A comma is usually put after the word *dividens* but erroneously. Mr. *Baxter* discerned, it ought to be after the word *plerumq*; otherwise

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'tis not agreeable to that good sense we ought to find in our poet : and it now shows he was a philosopher too.

It may thus be translated, and too well accommodated to the present times.

Seldom do I observe the sacred day,
And when at Temple, small devotion pay
To the great Deity ; but rather stand
A hero in the unbelieving band ;
From terrors of a future judgment freed,
To *Epicurus*, I refer my creed :
But all in vain. For hitherto great *Jove*,
Who o'er the clouds his thund'ring chariot
drove ;

Of late his fiercest lightning has been seen
To dart impetuous, thro' the sky serene.
The solid earth an awful tremor feels,
The rivers dance before his chariot wheels.
To *Africk's* shores the rapid shock extends
E'en to the dreadful *Stygian* cave descends.
The yawning realm of *Tænarus* appears
Awakens conscience with unusual fears.

Read at the *Royal Society*,
January 15,
1756.

W. Stukeley.

F I N I S.